Mathematical Techniques for Atmospheric Convection to Improve Severe Weather Prediction

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Some of the most extreme weather on the planet is associated with deep convective storms driven by the heat released when water vapour turns into liquid cloud water or ice. These storms start out as small turbulent eddies which grow into violent thunderstorms. Storms can organise into much larger structures such as squall lines and tropical cyclones. This ever-larger scale organisation nevertheless remains, in part, controlled by processes occurring at the smallest turbulent scales. The smallest scales are not represented accurately in models used to predict the weather, which compromises the accuracy of weather forecasts. This project is aimed at evaluating new approaches to the representation of the smallest scales.

The student will use and compare two types of averaging for deriving equations that represent the sub-grid scale variability associated with convection. Conditional averaging assumes two values of momentum, temperature and density per grid box in order to represent the conditions in both the convectively active (cloudy) and stable (clear sky) regions of the atmosphere. Volume averaging involves predicting means, standard deviations and correlations between variables. The project will start by assessing which averaging technique can best represent high resolution data at low resolution. However the representation of the data is just the start. The big challenge lies in predicting the transition between small scale, turbulent motion and deep convection. High resolution data will be analysed to find relationships between terms in the averaged equations and the growth of convection.

This project is part of "Project Circle-A. Parametrizing Convection in the Hard Grey Zone" at Reading which is part of the NERC/Met Office programme "Understanding and Representing Atmospheric Convection across Scales". The student will therefore be part of a national network. This is an opportunity to contribute to model development that will directly feed in to weather and climate forecasting.

Training and development opportunities: Courses on atmospheric science and numerical modelling are available. There will also be opportunities to attend summer schools and conferences. The student will acquire transferable skills in computational techniques and skills highly relevant to research and operational careers in meteorology.

Student profile: This project would be suitable for students with a degree in mathematics, physics, engineering or a closely related discipline with a desire to write good code.

Funding for UK students for full fees, the standard maintenance grant and national and international travel.

Starting As soon as possible.